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Invasive Plants Field and Reference Guide:

An Ecological Perspective of Plant Invaders of Forests and Woodlands

Cover photograph: *Berberis thunbergii* invading a disturbed forest (C. Huebner).

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An Ecological Perspective of Plant Invaders of Forests and Woodlands

Cynthia D. Huebner[1,2]

with
Cassandra Olson[3]
and
Heather C. Smith[2]

[1] **Author for Correspondence (chuebner@fs.fed.us)**

[2] **USDA Forest Service**
Northeastern Research Station
Morgantown, WV 26505

[3] **USDA Forest Service**
Forest Inventory and Analysis
North Central Research Station
St. Paul, MN 55108

INTRODUCTION

Purpose of This Field Guide:

There are many field guides available about invasive plants and their identification. The purpose of this particular field guide is to give a scientific synthesis of what is known about the behavior of such species in managed, disturbed, and pristine forested systems in addition to key information for accurate identification. Such information will be helpful when prioritizing research questions and choosing the best control strategies. Control methods for each species are not provided. The most successful control methods are most often site-specific; over-generalizing control methods might lead to poor management and frustrating outcomes. This is not to say that the information that is available should not be used; this guide just could not do it justice and still achieve its primary goals.

Four Goals:

1. While there is a great deal of publicly available information about many invasive plants, much of this information lacks corresponding citations for verification. The first goal of this guide is to help provide such information, using mostly peer-reviewed scientific publications and other primary sources. If information about a species provided in other guides or Web pages could not be verified by such sources, it was not included in the species description. As research and information about each species improve and increase in volume, it is likely that some of the research synthesis will need to be organized for each species in a separate reference book that will accompany this guide in the future.

2. Despite the scientific nature of Goal 1, the second goal is to make this guide accessible to a variety of people, including private landowners and managers as well as researchers. We do this by providing simple, cursory descriptions that can then be read about in more detail (if desired) using the corresponding citations. A glossary is provided to help explain some of the more botanical terms and phrases that could not be avoided.

3. The third goal is to emphasize the dynamic nature of invasions and science. Species will be added and updated on an annual basis. Because this can become quite costly in terms of complete hardcopy publications, new species will be provided on an individual basis rather than by printing new field guides annually.

4. The last goal is to provide a useful, true-to-form field guide that can be used extensively in field situations. This requires that the guide be small and weatherproof. In addition, not every species included will necessarily be of interest to each user at a given point in time, which is why we chose to have removable pages. This also allows one to easily add new pages to their guidebook, ordering one or many new pages at a time as they become available.

A Collaborative Effort:

The USDA Forest Service recognizes that the threat of invasive plant species to public and private forests is serious and that successful progress in prevention, control, research, and restoration from the negative impacts of such invasions is only possible using a concerted and organized effort. Thus, the Forest Service-Eastern Region (Region 9), the Northeastern Area (NA) State and Private Forestry, and the Northeastern Research Station have joined forces to put this guide together for the public. This guide would not have been possible without the guidance and funding provided by Nancy Berlin (Region 9) and several Region 9 botanists (see acknowledgements) as well as Don Dagnan and Noel Schneeberger (NA State and Private Forestry).

This is a work in progress; information and comments from the users of this guide are very welcome.

Guide Organization:

This guide contains 15 species (see list after the Introduction) that are potential invaders of forests and woodlands. Such invaders pose a threat by invading forests of various ages, ranging from a recently harvested forest or woodland to an old-growth forest. New species will be added using a prioritized

list of 50 species, which will likely grow in number. Currently, the next 15 species to be included (in alphabetical order) are *Akebia quinata*, *Ampelopsis brevipedunculata*, *Cirsium arvense*, *Coronilla varia*, *Euonymus alatus*, *Euonymus fortunei*, *Euphorbia esula*, *Hesperis matronalis*, *Ligustrum obtusifolium*, *Lonicera morrowii*, *Rumex acetosella*, *Ranunculus ficaria*, *Rhamnus frangula*, *Vinca minor*, and *Vincetoxicum nigrum*.

Because this guide is dynamic in terms of new additions over time, there are no page numbers. Instead, this guide is organized by habit type (herb, vine, shrub, or tree) and then alphabetically by scientific name, making it easy to insert new species as they become available. A list of species by both scientific and common name is provided in this current guide and will be updated as new species are added. Notification of new species syntheses will be posted on the Web pages of the Northeastern Area State and Private Forestry, Forest Service-Eastern Region (Region 9), and Northeastern Research Station. You may also request to be placed on a list for such notifications by contacting Cynthia Huebner at chuebner@fs.fed.us.

Within each species description, the more common Latin synonyms are provided, but are not comprehensive. Also, the Natural Resources Conservation Service species code, which is commonly used by Forest Inventory and Analysis and other organizations, is also provided. Citations, which are referenced in the text with small numbers, are listed in the back (after the glossary) by habit and by species' Latin names. The order of the numbers in the descriptions reflects source importance.

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Species List

By Scientific Name

Herbs
Alliaria petiolata – garlic mustard
Fallopia japonica – Japanese knotweed
Heracleum mantegazzianum – giant hogweed
Microstegium vimineum – Japanese stilt grass

Vines
Celastrus orbiculatus – oriental bittersweet
Lonicera japonica – Japanese honeysuckle
Polygonum perfoliatum – mile-a-minute weed
Pueraria montana var. *lobata* – kudzu vine

Shrubs
Berberis thunbergii – Japanese barberry
Elaeagnus umbellata – autumn olive
Lonicera maackii – amur honeysuckle, bush honeysuckle
Rhamnus cathartica – common buckthorn
Rosa multiflora – multiflora rose

Trees
Acer platanoides – Norway maple
Ailanthus altissima – tree of heaven

Species List

By Common Name

Herbs
Garlic mustard – *Alliaria petiolata*
Giant hogweed – *Heracleum mantegazzianum*
Japanese knotweed – *Fallopia japonica*
Japanese stiltgrass – *Microstegium vimineum*

Vines
Japanese honeysuckle – *Lonicera japonica*
Kudzu vine – *Pueraria montana* var. *lobata*
Mile-a-minute weed – *Polygonum perfoliatum*
Oriental bittersweet – *Celastrus orbiculatus*

Shrubs
Amur honeysuckle, bush honeysuckle – *Lonicera maackii*
Autumn olive – *Elaeagnus umbellata*
Common buckthorn – *Rhamnus cathartica*
Japanese barberry – *Berberis thunbergii*
Multiflora rose – *Rosa multiflora*

Trees
Norway maple – *Acer platanoides*
Tree of heaven – *Ailanthus altissima*

GARLIC MUSTARD
[*Alliaria petiolata* (M. Bieb.) Cavara & Grande*; A. officinalis* Andrz.]
ALPE4

Habit: Erect, shade-tolerant,[4] biennial herb.[8]

Reproduction: By seed;[8] preferentially outcrosses but may self.[6]

Leaves: Lower leaves kidney shaped with palmate venation, 2-12 cm (¾ to 4¾ in) long, arranged in a basal rosette that forms the first year and persists through winter; upper leaves alternate, triangular, toothed.[15,8,4,7]

Stems: Up to about 1 m (3 ft); one flowering stem per rosette, but up to six;[4,17] may branch.[8,4,7]

Flowers: Second year; numerous; 5-7 mm (¼ in) in diameter, white, 4-petaled; mostly in a cluster at the top of the stalk but may occur in leaf axils;[8,4] bloom late April-June;[15,8] open from bottom to top; remain open for 2-3 days, but produce nectar primarily in day 1; pollinated by medium-sized, short-tongued bees and flies, which visit one or two flowers per plant.[6]

Fruits/Seeds: As many as 3,000 seeds per plant; seeds dark brown to black,[8,4] enclosed in long (4-7 cm; 1½-2¾ in), narrow capsules (siliques);[8,7] dispersed in late summer; cold stratification required to break dormancy;[2,10] germination best in dark, moist conditions and lower temperatures (1-5°C; 34-41°F); small seed banks are formed; large, persistent seed banks unlikely due to high germination rates[2] but may be more likely in drier conditions;[3] germinants do not compete well with second-year rosettes;[2,11] animal and water dispersed.[4]

Habitat: Native to Europe; first U.S. introduction in 1868;[12] in upland or floodplain forest, savannas, roadsides, trail edges, and disturbed areas; shady, mesic areas with alkaline soils[3,18] but found in high light, xeric areas with acidic soils.[3,1]

Comments: Nutritious;[9] rare native butterfly oviposits on it but larvae cannot feed;[13] herbivory defenses increase with wounding; levels vary among populations;[5] allelopathic impact documented,[14] possibly via effect on native plant mycorrhizae.[16]

Similar Native Species: Basal leaves of *Thaspium, Zizia, Senecio, Viola* spp; similar fruiting structures with several other mustards.[8]

GARLIC MUSTARD

Alliaria petiolata (M. Bieb.) Cavara & Grande

JAPANESE KNOTWEED
[*Fallopia japonica* (Houtt.) Ronse Decraene; *Polygonum cuspidatum* Sieb. & Zucc.; *Reynoutria japonica* Houtt.]
POCU6

Habit: Perennial, herbaceous shrub 3 m (10 ft) or taller;[8,20,21,7] shoots survive one season; rhizomes survive decades; circular clonal stands formed in native habitat, senescing centrally.[1]

Reproduction: Primarily vegetatively via rhizome or shoot fragments;[4,19,7,3] by seed;[8,20,6,7] dioecious;[8,6] or gynodioecious;[3,7] viable, fertile hybrid (*F.* x *bohemica*) result of cross with *F. sachalinensis* (also non-native and invasive).[11,3]

Leaves: Simple and alternate; broadly ovate, 8-15 cm long, 5-12 cm wide (3⅛-6 in x 2-4¾ in), with abruptly pointed tip, truncate base;[8,6] stipule (ocrea), a tubular, membranous sheath.[6,3]

Stems: Round, sometimes ridged,[8] glaucous, often mottled;[6] hollow internodes[7] with swollen nodes.[20,6]

Flowers: Mid-late summer; small (2-3 mm or ⅛ in),[3] greenish-white,[20,8,6] 1,000s/plant;[7] narrow inflorescences at middle/upper nodes;[20,8,6] fly and bee pollinated; copious nectar,[3] from which bees produce a dark, quality honey.[2,17]

Fruits/Seeds: Fruits 3-winged, 8-9 mm or ¼-⅜ in; seeds (3-4 mm or ⅛ in) dark, glossy;[8,20,6] germination rate 61-95% in light and room temperature; no apparent cold stratification requirement;[7] wind,[13] possibly water dispersed (like rhizome and shoot fragments); at least one bird species eats the seeds.[3]

Habitat: Native to Asia; introduced to the U.S. in the mid-late 1800s;[7] disturbed and riparian areas, roadsides, woodlands; shade intolerant;[3] native substrate volcanic[14] with low pH; grows in a variety of pH levels and soil types; preference for wet habitats;[3] seedling survival dependent on water; adults tolerate drier conditions;[13] USDA hardiness zones 4-8.[5]

Comments: Tetraploid, hexaploid, or octoploid;[12] polyploidy may increase genetic diversity;[10] translocates N to radial clones until clones take up own N;[1] most N in roots if N is limiting;[9] C remobilized to rhizomes prior to shoot senescence;[18] treatment for skin disorders, hepatitis, inflammations, natural estrogen substitute;[15] exudes large quantity of guttation fluid;[16] grazed by sheep, cattle, horses; *F. japonica* var. *compactum* also escapes.[3]

Similar Native Species: Virginia knotweed (*P. virginianum*); not a shrub; ocreae with bristles; inflorescence a slender spike.[8,20]

JAPANESE KNOTWEED

Fallopia japonica (Houtt.) Ronse Decraene

GIANT HOGWEED
[*Heracleum mantegazzianum* Sommier & Levier.]
HEMA17

Habit: Biennial or perennial herb with a deep (40-65 cm or 16-26 in), branching tap root;[9] blooms once then dies (monocarpic);[4,9] some perennials have survived after flowering.[9]

Reproduction: By seed; cut stems may re-sprout; self-compatible, outcrossing, protandrous hermaphrodite.[9]

Leaves: Alternate;[4,8,9] up to 3 m (10 ft) long, three-parted and pinnate;[4] pubescent beneath;[8] petiole base enlarged, surrounding the stem;[4] upper leaves become gradually smaller.[8]

Stems: Often purple-mottled, 2-5 m (7-16 ft) tall, up to 10 cm (4 in) in diameter; hollow and ridged.[4, 8, 9]

Flowers: Compound umbel up to 1.5 m (5 ft) in diameter with 50 to 150 rays; white ;[4,9] most plants flower in third or fourth year;[2,9] June-August;[8,9] pollinated by a variety of insects, mostly bees and flies; self-pollination may occur between different umbels.[5,9]

Fruits/Seeds: Fruit elliptic, ridged, and winged, 8-15 mm (⅜-⅝ in) in length on elongate stalks; splits in half, each half with one seed; shed Aug.-Oct.;[4,8,9] over 100,000 seeds per plant possible;[9] water, wind, or human dispersed, mostly within 10 m (33 ft) of mother plant;[2,6,9] germination appears to require moisture and cold stratification[7,9] and will occur in light or dark; viability ranges between 2-15 years.[9]

Habitat: Native to southwestern Asia;[9] introduced as an ornamental;[2] waste places, roadsides, disturbed woodlands, and streambanks;[2,8] may invade a range of habitats,[3,10] but possible preference for open, mesic, and seasonally cold environments.[7,9]

Comments: Sap has secondary compounds (furanocoumarins) that may cause blistering and rashes on humans, with sun exposure;[3,9] some of the same substances inhibit insect herbivory by generalists but specialist insect herbivory is common;[1] cattle, sheep, goat, pig, mollusc, and snail grazing are common; fungal pathogens are noted;[9] an *H. mantegazzianum* x *H. sphondylium* (native to UK) hybrid with low fertility is rare in the UK.[5,6]

Similar Native Species: Cow-parsnip (*H. lanatum*); flower usually has only 15-30 rays and stem reaches only 3 m (10 ft).[4]

GIANT HOGWEED

Heracleum mantegazzianum Sommier & Levier.

JAPANESE STILT GRASS
[*Microstegium vimineum* (Trin.) A. Camus*; Andropogon vimineus* Trin.*; Eulalia viminea* (Trin.) Kuntze]
MIVI

Habit: Reclining, loosely branching annual to 1 m (3 ft).[16,8, 6,11]

Reproduction: By seed;[6,16, 8] may root at lower nodes.[10]

Leaves: Mid-vein of leaf blade offset from center; a line of silvery hairs runs down the mid-vein on upper surface; lanceolate, tapering at both ends, 5-10 mm (¼-⅜ in) wide, 3-8 cm (1⅛-3 3⁄16 in) long; pale green; leaf sheath collars with ciliate hairs.[16, 8,14]

Stems: Reclining and branching; nodes glabrous and slightly swollen.[6,8,14]

Flowers: Late summer/early fall; terminal spike-like, branching inflorescence up to 7 cm (2¾ in) long with paired, hairy spikelets; in one variety, one spikelet is awned; another variety both are awnless;[5] may have both cleistogamous and chasmogamous flowers;[18] chasmogamous flowers associated with populations in high light[1] and under water stress;[7] shade populations primarily cleistogamous; potentially highly selfed;[7] flowering plants tend to be larger than non-flowering plants.[7]

Fruits/Seeds: Ellipsoid grain 2.8-3.0 mm (⅛ in) long; abundant seed production may occur infrequently;[7] seed bank of at least 3 years;[1,7] seeds mature and are dispersed in late fall[16] when they appear to be dormant; cold stratification may be required for germination;[7] water and animal dispersed.[14]

Habitat: Native to tropical Asia;[17,16,8] introduced into the U.S. in 1919;[5] shade tolerant;[19] preference for shady areas (closed canopy forests, especially riparian areas) but found in high light areas (roadsides, ditches, forest borders, and fields);[15] possible preference for bare ground, disturbed and acidic soil.[1,20, 11,15]

Comments: C_4 photosynthesis;[19,2,3] may acquire more light energy using sun flecks;[9] has a lower capacity to photosynthesize in high light;[19] forms a thick thatch of litter, which may prevent establishment of natives and itself;[7] may alter soil conditions to its benefit by increasing pH, nitrification, and nitrate;[1,4] association with non-native earthworms possibly due to increased litter decomposition or an agricultural connection.[12,13]

Similar Native Species: *Leersia virginica*; has hairy nodes, is a perennial, and flowers earlier.[14]

JAPANESE STILT GRASS

Microstegium vimineum (Trin.) A. Camus

ORIENTAL BITTERSWEET
[*Celastrus orbiculatus* Thunb.]
CEOR7

Habit: Deciduous, woody, twining vine.[6]

Reproduction: By seed and vegetatively[6] by root suckering;[3] dioecious; some perfect;[6] some plants monoecious.[8,3]

Leaves: Alternate, entire leaves with shallow teeth; shape variable but most often less than twice as long (5-12.5 cm; 2-5 in) as wide, round with an abruptly pointed tip.[6,2]

Stems: Light brown;[2] may reach up to 5-10 cm (2-4 in) in diameter and up to 18 m (59 ft) long;[2,9,4] may impact host species by reducing photosynthesis and causing structural damage.[3,11]

Flowers: Short, axillary inflorescences with only a few flowers (whitish-greenish); each inflorescence subtended by a leaf longer than the inflorescence;[6] May-June;[15] insect or wind pollinated.[1,21]

Fruits/Seeds: Fruit, adjacent to a vegetative bud, matures late summer/early fall, often remaining on the vines through winter; most fall to the ground by early winter;[7] yellowish outer skin covers a red, fleshy aril containing 3-6 seeds;[3] dispersal by humans, birds (131 m; 430 ft),[16] or small mammals;[3] most often ingested in winter; defleshed seeds have higher germination rates than scarified (due to ingestion) seeds;[7] no apparent seed bank.[19]

Habitat: Native to Japan, China, and Korea; not a forest species in native habitat;[17] introduced into the U.S. in 1860;[7] open areas; early/late-successional forests;[3,17] USDA hardiness zones 4-7.[2]

Comments: "Sit and wait" strategy of invasion; germinates best in shade, but prolific growth may not take place without light;[7,13] hybridizes with the native *C. scandens*, producing a sparingly fertile hybrid[20] that is more vigorous than the native;[14] very low root pressure, but conducts water at rates equal to native vines with high root pressure; despite evident embolism, keeps leaves for ~1 month after first frost; greater rates of secondary growth than a native grape species;[18] may facilitate grape vine growth;[5] evidence of medicinal properties for rheumatoid arthritis[12] and reversing cancer cell resistance to treatment drugs.[10]

Similar Native Species: Bittersweet (*C. scandens*); leaves tend to be more than twice as long as wide; inflorescences terminal and not next to a vegetative bud.[8,15]

ORIENTAL BITTERSWEET

Celastrus orbiculatus Thunb.

JAPANESE HONEYSUCKLE
[*Lonicera japonica* Thunb.]
LOJA

Habit: Perennial, semi-evergreen to evergreen[9,3,5] vine that trails or climbs to 7 m (23 ft).[15]

Reproduction: Vegetatively; stem cuttings;[1] by seed;[12,21,11,3,30] may be pollinator limited;[1,16,5,22] obligatory outcrosser.[16]

Leaves: Opposite, entire, oblong, 4-8 cm (1½-3⅛ in); base round/triangular; may have lobes or teeth; lower surface often lighter green than upper; surfaces may have a few hairs. [9,15,5]

Stems: Young stems pubescent, reddish/light-brown;[9,15,12] climber internodes shorter in length than those of trailers.[28]

Flowers: May-June;[15,21,16] white-cream-pink,[15,12] yellows with age;[21,15] 2.5-3.8 cm (1-1½ in), 2 reflexed lips; stamens extend beyond lips; paired at each node;[15] fragrant,[19] tubular, pubescent inside[11] with glandular hairs bearing nectar;[22] open at dusk, maximizing visits from diurnal (bees) and nocturnal (moths) pollinators; nocturnal pollinators disperse pollen further;[19] may be best adapted for hawkmoths,[16,20] which are attracted to rhythmic linalool emission (highest first midnight of 2-day flowering period[20]); diurnal pollinators remove more pollen but with less efficiency than hawkmoths.[19]

Fruits/Seeds: Sept.-Oct.;[15,21] black, glossy fruit 0.6 cm (¼ in) long[15,12] with 4-10 brown-black seeds;[15] viability may be low;[13] dispersed by deer, rabbits, bobwhites, turkeys,[10] and other birds.[15]

Habitat: Woods, fields, disturbed areas, roadsides, bottomlands, and fence rows;[12, 21, 27] tolerates shade but most growth in full sun; rarely flowers in low light;[23] not as shade tolerant as some native vines;[4] sensitive to dry conditions;[2] responds positively to an increase in CO_2;[24] USDA hardiness zones 4-9.[9]

Comments: Native to E. Asia;[12] introduced into the U.S. in mid 1800s [17,26] for horticultural purposes and soil stabilization;[15] negative impacts (lower leaf N, photosynthesis, growth) on a native host all primarily due to root competition;[6,7,8] diploid; less genetic diversity than *L. sempervirens* (tetraploid, native vine);[25] greater annual carbon gain than this native;[27] forage for deer,[31,29] but this native preferred; herbivory increases growth;[26] anti-inflammatory[18] and anti-bacterial/viral properties;[14] 6 cultivars.[9]

Similar Native Species: *L. sempervirens*; leaves glaucous (both surfaces), flowers terminal, and connate terminal leaves.[12,21]

JAPANESE HONEYSUCKLE

Lonicera japonica Thunb.

MILE-A-MINUTE WEED
[*Polygonum perfoliatum* L.; *Ampelygonum perfoliatum* (L.) Roberty & Vautier; *Tracaulon perfoliatum* (L.) Greene[9]]
POPE10

Habit: Annual, shallow and fibrous-rooted, climbing vine[4,15] to 6-8 m (20-26 ft);[10,15] may behave as a perennial (with a tap root) in subtropical climates.[12,15]

Reproduction: By seed;[12] perennials may root at the nodes.[15]

Leaves: Alternate, simple, entire, glaucous, and glabrous; with recurved prickles on lower veins and petioles;[5] triangular in shape and bright to pale green in color (sometimes reddish when young); 3-8 cm (1 3/16-3 3/16 in) long and 5-9 cm (2-3½ in) wide; peltate with the petiole;[3,4] sheathing stipule (ocrea) at petiole base encircles the stem (perfoliate).[4,3,9,2,12]

Stems: Wiry, slender, and armed with small, recurved prickles;[2,8] climbing or reclining on other plants;[12] becoming reddish with age.[8,15]

Flowers: Small (1.5 mm or 1/16 in);[15] 10-15 in terminal or axillary spike-like racemes 1-2 cm (⅜-¾ in) long; perfect, greenish-white to pink;[4,12] bloom early summer to fall.[6,5]

Fruits/Seeds: Round, shiny, black achene;[12,15] perianth 3-5 mm (⅛-¼ in), persistent, thickening to a fleshy, berry-like, iridescent blue covering;[4,12] water, bird, small mammal, and human dispersed;[12,15,6] buoyant;[2,12] dispersed July-November;[9,12] germination mid-March to April;[6] cold stratification may be required in colder environments[1,8] but detrimental in warmer areas; scarification may promote germination;[8] persistent seed bank for at least 3 years.[13]

Habitat: Native to E. Asia;[2,4,6] introduced into the U.S. in 1890s[10] near Portland, OR, with no local spread;[13] found in Pennsylvania in the mid 1930s; along streams, in flood plains,[12] roadsides, disturbed sites (harvested forests), and open woodlands;[7,11] possible preference for moist soils.[5]

Comments: Easily spread in nursery stock;[5] relatively shade tolerant compared to native congeners;[5] performs better in open areas;[9] numerous native insects feed on it with little effect.[9,14]

Similar Native Species: *P. sagittatum* and *P. arifolium*; leaves not glaucous, peltate, or triangular and ocreae not perfoliate.[5,11,12]

MILE-A-MINUTE WEED

***Polygonum perfoliatum* L.**

KUDZU VINE
[*Pueraria montana* (Lour.) Merr. var. *lobata* (Willd.) Maesen & Almeida; *P. lobata* (Willd.) Ohwi.]
PUMOL

Habit: Perennial, twining vine[2] that trails or climbs to 30 m (98 ft);[10,5,19] legume (with nitrogen-fixing bacteria).[9]

Reproduction: Tubers, root suckers,[15] and runners that root at the nodes;[8,15] by seed;[8,10,5] successful seed production rare in cold climates;[19,16] stem cutting propagation not successful.[16]

Leaves: Alternate, trifoliate, up to 18 cm (7-8 in) long with long petioles; dark green and a pubescent underside; leaflets with smooth or lobed margin; middle leaflet usually with three lobes and equal base; side leaves 1-2 lobes and unequal bases.[19,10, 5]

Stems: Up to 2.5 cm (1 in) diameter (some 10 cm (4 in));[15] brownish; young stems with tan/bronze hairs;[10,19,5,15] may grow 30 cm (12 in)/day; die back in fall/winter;[15] some overwinter.[28]

Flowers: In leaf axils in elongate, branching racemes to 20 cm (8 in) long; up to 2.5 cm (1 in) wide; papilionaceous, reddish-purple, upper petal base yellow;[4,15] grape-scented odor;[10,19,5,15] May-Nov. on vertically growing plants[8] in direct sunlight.[15]

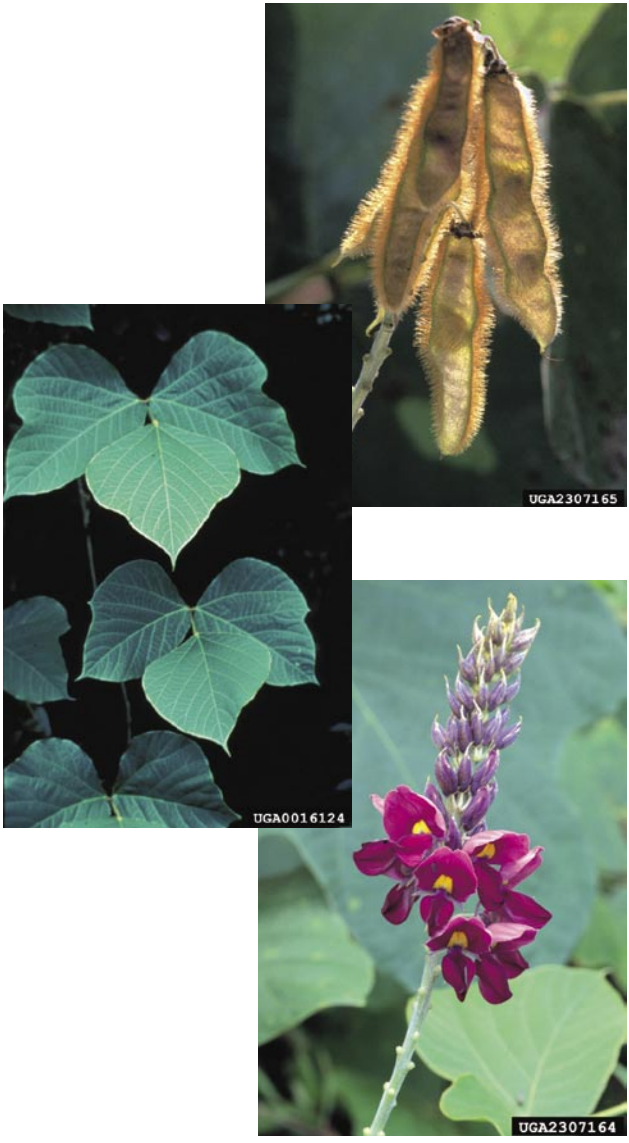
Fruits/Seeds: Early/late fall; flat, pubescent pod 4-5 cm (1½-2 in) long;[10,15] seeds kidney shaped, 3-4 mm (⅛-3⁄16 in);[30] germination at 15-35°C (59-95°F), in light or darkness, and best after scarification[24] (mechanical[27] or sulfuric acid[25]); cold stratification not required;[25] mammal and bird dispersed.[8]

Habitat: Native to China, E. Asia;[11,19] introduced into the U.S. in late 1800s;[11] forest edges, roadsides, old fields, and disturbed areas; shade intolerant,[2] but found in forests;[6,7] not tolerant of cold;[3] tolerant of compacted, nutrient-poor soils,[26] though P is limiting;[14] older plants with deep roots are more drought tolerant;[23] positive growth response to increasing CO_2.[21]

Comments: Uses include erosion control,[19,15] feed,[14,4] fiber,[29] ornamental,[11] starch,[1] and treatment for alcoholism,[18,13] colds, asthma, diarrhea, fever, and anemia;[23] used to improve soil in South American humid tropics;[20] high genetic diversity in the U.S.;[17] continental U.S. has this variety; *P. montana* var. *chinensis* is in Hawaii; variety hybridization occurs;[12] isoprene emission possible ozone source;[22] shading reduces root growth.[9]

Similar Native Species: *Dioclea multiflora*; fruit 2-winged along upper suture; flower smaller.[10]

KUDZU VINE



Pueraria montana (Lour.) Merr. var. *lobata* (Willd.) Maesen & Almeida

JAPANESE BARBERRY
[*Berberis thunbergii* DC.]
BETH

Habit: Spiny, deciduous shrub, to 2.5 m (8 ft) tall and wide.[7,2,10]

Reproduction: By seed;[7] cut stumps and stems;[2,16] may self or cross.[2]

Leaves: Alternate, simple, entire, spatulate, 1.3-2 cm (½-¾ in) long; bright green above, lighter below;[2,7,6] in clusters at each node;[2,10] fall color red to purple depending on the cultivar.[2]

Stems: Numerous, reddish-brown, angled or grooved, glabrous, usually with stiff, short, single spines 1.3 cm (½ in) long at the nodes;[2,17] older stems gray; inner bark yellow;[17,10] may be replaced every few years.[16,4]

Flowers: Small, perfect, 6 yellow petals, stalked; 1-4 in umbel-like clusters at the nodes; April–May;[7,2,10] nectaries located on both sides of the 6 stamens, which have a tripping mechanism; the first visit removes over 50% of the sticky pollen;[11] pollinated by bees.[12]

Fruits/Seeds: Early to late summer; bright red, dry, oblong to rounded berry 1-1.3 cm (⅜-½ in); 1 seeded;[6,10,7] may remain on the shrubs through winter;[2] production highest in high-intermediate light levels;[16] cold stratification and alternating temperatures improve germination;[1,14,16] over 90% of fruit falls within 1 m (3 ft) of each shrub but has been mapped as far as 80 m (262 ft); dispersed by birds (not a preferred food[16]), deer, turkey, and grouse;[3] fruit removal may be highest in low light.[16]

Habitat: Introduced into the U.S. between 1864-1879[2,16] from Japan; full sun to full shade; most soil types and habitats; dry ridgetops to wetlands and roadsides to closed canopy forests.[13,4]

Comments: Growth minimal in low light; survival of seedlings drops from 90% in intermediate-high light to 40% in low light, but survivors persist; leafs out before canopy and retains leaves after canopy leaf fall;[16] deer herbivory minimal,[3] but severe winter damage from rabbits;[18] mortality of stems or shrubs not related to population density;[4,16] at least 47 cultivars;[2] may alter soil conditions to its benefit by increasing pH, nitrification, and nitrate;[5] association with non-native earthworms possibly due to increased litter decomposition or an agricultural connection.[8,9]

Similar Native Species: American barberry (*B. canadensis*); toothed leaves and usually 3-pronged spines.[15]

JAPANESE BARBERRY

Berberis thunbergii DC.

AUTUMN OLIVE
[*Elaeagnus umbellata* Thunb.]
ELUM

Habit: Deciduous, shrub or small tree up to 6 m (20 ft) tall and up to 9 m (30 ft) wide;[8,13,12,4] nitrogen-fixing actinorhizal (by the actinomycete *Frankia*[9]) root nodules present.[15]

Reproduction: Primarily by seed;[8] propagation by stump sprouting, by roots, and, for the Ellagood cultivar, by cuttings.[16]

Leaves: Alternate, simple, oval, entire and wavy; gray-green, silvery scaly beneath, with a shimmering appearance;[12,8,13] young leaves may be silvery on both sides.[4]

Stems: Twigs silvery or golden brown; often thorny[12,8,13] with brownish scales, giving a speckled appearance.[4,12]

Flowers: Clusters of 1-8 in leaf axils; fragrant, tubular, cream to light yellow;[12] April-June;[12,8,13] exterior silvery-scaly; 4 petals and stamens.[13,12]

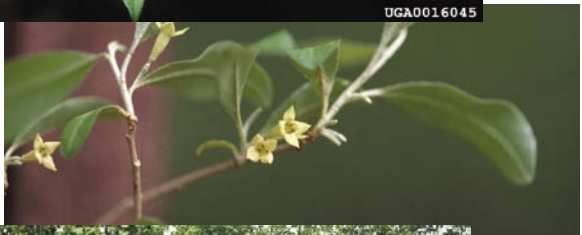
Fruits/Seeds: Fruit 6-8 mm (¼ in), fleshy, silvery with brown scales when immature, ripening to a speckled red[12,8,13] or yellow;[6] Sept.-Nov.;[13,12] edible (bitter to semi-sweet);[12] one seeded;[8,12,13] dispersed by birds (not preferentially eaten[14]) and water;[11] fruit high in lycopene;[6] cold stratification improves germination; optimal germination at alternating temperatures of 20-30/10°C (68-86/50° F);[1] persistent seed bank possible (seeds of *E. angustifolia*, a related non-native species, remain viable for 3 years in the lab and have a dormancy period[10]); one study found that despite relative abundance of the species (compared to 31 years ago), *E. umbellata* seeds were not in the seed bank.[3]

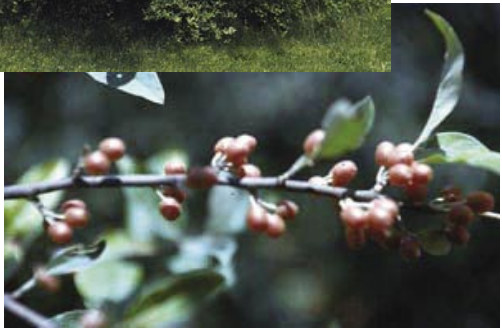
Habitat: Native to Asia; open woods, forest edges, roadsides, riparian areas, fence rows, meadows, pastures, sand dunes, mine spoils, other disturbed areas;[12,13,3,14,11] possibly shade tolerant; tolerant of infertile and dry soils;[5] acidic soils may reduce survival of seedlings;[2] USDA hardiness zones 4-8.[4]

Comments: At least 5 cultivars;[16] increases soil nitrogen, which may be beneficial to black walnut[7] or have a negative impact by increasing invasion of other exotics or by changing ecosystem properties, neither of which is confirmed for this species yet.

Similar Native Species: Silver-berry (*E. commutata*); but thornless with egg-shaped, shorter leaves that are silver-brown and scaly on both sides.[8]

AUTUMN OLIVE





Elaeagnus umbellata **Thunb.**

AMUR HONEYSUCKLE
[*Lonicera maackii* (Rupr.) Herder; *L. maackii* (Rupr.) Maxim.]
LOMA6

Habit: Deciduous shrub up to 5 m (16 ft) tall and wide.[6,12,5,19,16]

Reproduction: By seed; main stem may re-sprout; cut young stems and bare roots may root.[6,5,22]

Leaves: Opposite, inverted egg-shaped; broadest in middle, tapering at both ends, 3.5-8.5 cm (1½-3½ in) long, tip abruptly pointed; petiole short, pubescent;[6,12,19] margin entire, fringed with hairs; upper surface dark green, paler below; both surfaces have hairs on the veins;[6,12,2] leaf-out before most woody deciduous species;[12] senescence later than several species.[4]

Stems: Grayish-brown, with short hairs on young stems; broad ridges and grooves appearing striped on older stems; internodes hollow; nodes and young stems may have white-tan pith.[12,5]

Flowers: Usually two at a node; 15-20 mm (½-¾ in) long;[6,12] May-June; on 5- to 8-year-old plants;[3] white, aging to yellow;[6,12,19] flower stems shorter than leaf petioles;[12,19] two lipped, anthers longer than the lips;[12] nectar mostly sucrose, attracting primarily bees; ~21,000 flowers/shrub, ~34 g sugar/day/shrub.[21]

Fruits/Seeds: Bright red at maturity in late summer-fall;[19,12] pulpy berry with 1-6 seeds (pers. obs.); may require cold, warm, or no stratification; optimal germination at 25 or 15°C (77 or 59°F) in light;[1,9] 54-81% germinate in warm, moist conditions in light (30-55% in dark); seed bank unlikely;[15,14] bird dispersed; the lipid-poor fruit not preferred;[11,23] small mammals consume seeds despite bitter seed coat; not a significant part of diet.[24,25]

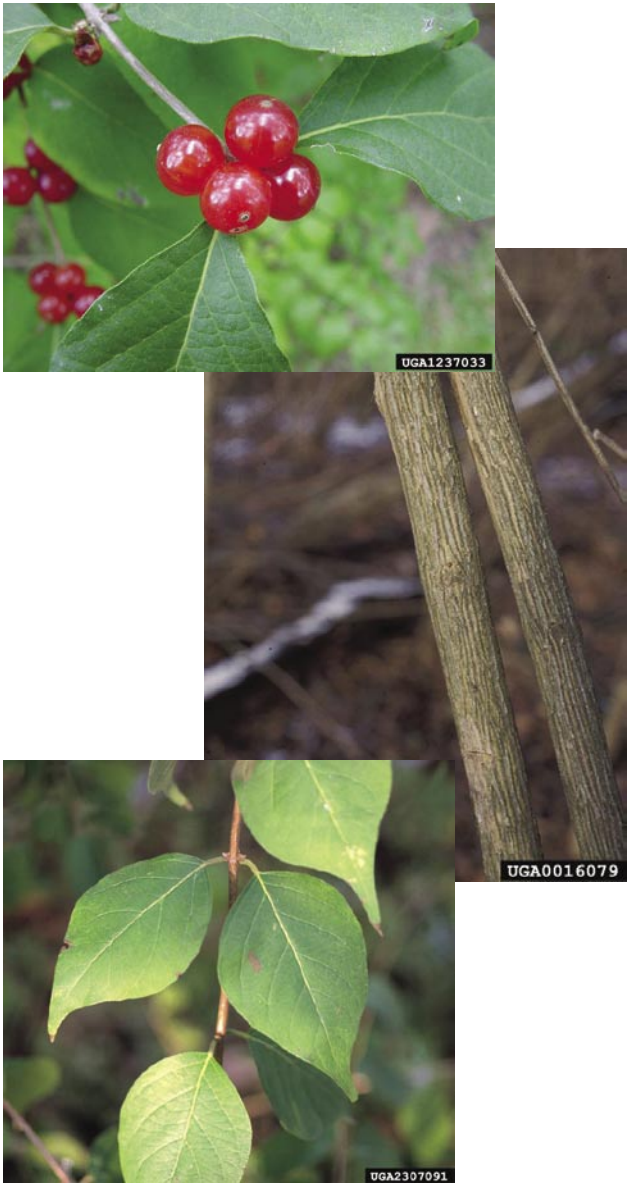
Habitat: Native to Eurasia; introduced into the U.S. late 1850s;[5,13] urban areas, old fields, flood plains, upland/lowland forests (early-late successional), disturbed ground, wood edges, and roadsides;[12,19] USDA hardiness zones 3-8.[5]

Comments: Stratification inconsistencies may be cultivar-dependent (rem-red requires cold; cling-red does not);[22] higher growth rates and fitness in high light;[10,14,17,13] removal tests show increased survival/fecundity of associated natives;[8,7,18] American robins preferentially nest in *L. maackii* despite higher predation rates (nests are lower) compared to native shrubs.[20]

Similar Native Species: *L. canadensis;* smaller; flowers not strongly bilabiate; leaves not abruptly pointed.[6]

SHRUB

AMUR HONEYSUCKLE



Lonicera maackii **(Rupr.) Herder**

COMMON BUCKTHORN
[*Rhamnus cathartica* L.]
RHCA3

Habit: Deciduous shrub or tree to 8 m (26 ft) and as wide.[7,17,4,3]

Reproduction: Primarily by seed; may sucker from base; dioecious.[7,17,4]

Leaves: Elliptic to oblong/obovate, 3-7 cm (1¼-2¾ in); twice as long as wide; pinnately veined, lateral veins curving upward;[7,14,17] opposite, some alternate, often abruptly pointed with rounded teeth (each bearing a gland[14,18]) on the margin;[7,17] upper surface dark green, lower light green;[7,14,3] yellow/brown in fall;[3,8] downy beneath if young;[8] early leaf-out,[9] late senescence; leaf lifespan exceeds that of native shrubs by 58 days.[9,1,3]

Stems: Branches opposite (or nearly) at right angles to trunk;[8] some twigs end in a short thorn;[7,17,8,3,14] grayish/yellowish-brown, glabrous;[3,14] trunk becomes scaly with age.[18,14]

Flowers: Male 2-6 per cluster with 4 yellowish-greenish petals and sepals, 4 stamens; female 2-15 per cluster, usually without petals, if present, linear and yellowish-brown, 4 vestigial stamens, 4 green sepals shorter than those in the male;[14,7,8] April-June;[14] appear with the leaves;[7,17] females at a 6 to 1 ratio to males; honey-scented; calyx tube with nectarial lining; insect pollinated (bees and flies).[8]

Fruits/Seeds: Glossy black at maturity in late summer/early fall; fruit 0.5 cm (¼ in) in diameter; drupe contains 3-4 seeds;[8,4,7,3,17] cold stratification may[2] or may not[1] be required; optimal germination at 20 or 30°C (68 or 86°F);[2] most fruit falls beneath females; bird dispersed, but not preferred (even in native habitat);[8] seedling establishment more likely on ground with little herb cover;[6] dormancy and seed bank still unclear.[1,13]

Habitat: Native of Eurasia; introduced into the U.S. in 1880s;[21,1] on calcareous soils in native habitat;[8,1] open/shaded areas, roadsides, woodlands, riverbanks (not flooded[5]), pastures,[1,12,17,19] and mature forests;[9] tolerates various soil conditions.[1]

Comments: An alternate host for oat crown/leaf rust[15] and an overwintering host of soybean aphid;[20,16] early leaf-out more important than late senescence for carbon gain;[9] growth rates higher in light;[10] leaves decompose more rapidly than some natives and are high in nitrogen;[11] USDA hardiness zones 3-7.[3]

Similar Native Species: *R. caroliniana*; flowers perfect and in parts of 5; leaves alternate.[7,17]

COMMON BUCKTHORN

***Rhamnus cathartica* L.**

MULTIFLORA ROSE
[*Rosa multiflora* Thunb.]
ROMU

Habit: Perennial, deciduous shrub up to 5 m (16 ft) and as wide; long, slender, arching branches.[11,16,15]

Reproduction: By seed; stem sprouts,[11,16] shallow root sprouts, and layering (rooting cane tips that touch the ground);[23] colonial;[16] may self-fertilize or outcross (also with other roses, i.e., *R. wichuraiana* (non-native tetraploid)); male-donor-tetraploid crosses have larger fruit, more seeds.[17]

Leaves: Alternate, pinnately compound with 5-11 elliptic to obovate leaflets 2.5 cm (1 in) long with fine teeth;[16,23,31] underside of leaflets with hairs and paler than upper surface;[23,31] base of leaves have a fringed stipule.[16,23,31]

Stems: Flexible, green-red; rigid, recurved thorns with a wide base;[23] thornless cultivar exists.[8,4]

Flowers: White or slightly pink, numerous, arranged in terminal panicles; 1-4 cm (⅜–1½ in) wide; May-June.[15,23,16]

Fruits/Seeds: Clustered, hard, maturing to red; 5-7 mm (¼ in) wide, egg-shaped; glossy, smooth; Sept.-Oct.,[23,11] lasting into winter;[11] yellowish seeds;[23] dispersed by turkeys, deer mice,[36] birds (some migratory);[27,28] seed bank[24] active up to 20 years;[21,25] cold stratification required;[1,4] germinates best in light (~60%); less than 10% in dark;[37] optimum germination at 10-20°C (50-68°F)[38] or 5°C (41°F)[1,38] after a long period.[38]

Habitat: Streambanks, pastures, roadsides,[9] forest canopy gaps, disturbed areas, and mature forests;[20,31] introduced into the U.S. from Asia ~1886;[25] promoted in 1930s and '40s by government agencies as a 'living fence,' a soil stabilizer, and wildlife food/cover;[9,12,19] tolerates a variety of soils;[11,33,26] USDA hardiness zones 5-8.[11]

Comments: Used as rootstock for other roses[32,34] but not the best choice for longevity and flower production;[22] repeated herbivory lethal;[3,25] rose rosette disease (also affects other cultivated and native roses;[5,14]) may be lethal;[10,13,19] responds well to mycorrhizal inoculation;[6,7,30] preferential nest site for veeries,[18] other birds,[35] and mammals, such as rabbits;[2] at least 3 cultivars;[11] 371 rose species considered its progeny.[29]

Similar Native Species: *R. carolina* (pasture rose) and *R. blanda* (smooth rose); stipules not fringed.[16]

SHRUB

MULTIFLORA ROSE

Rosa multiflora **Thunb.**

NORWAY MAPLE
[*Acer platanoides* L.]
ACPL2

Habit: Deciduous tree reaching 30 m (98 ft) in height.[4,2]

Reproduction: By seed;[4] can be propagated from roots[9] or cuttings.[2, 9]

Leaves: Opposite, green to bronze, smooth, 5-7 lobed with few teeth and broad bases up to 18 cm (7 in) wide; wider than long; petioles with milky juice, best seen at base of petiole;[4,3] fall leaf color tending to be bright yellow.[2]

Stems: Trunk with widely spreading branches (cultivar-dependent; some have narrow canopies) and close bark;[3] twigs are olive brown and leaf scars meet to form a sharp angle; buds are plump, fleshy, and green to maroon.[2]

Flowers: Stalked, yellow-green, and perfect; appearing before[2] or with the leaves in spring, in loose clusters (corymbs).[3]

Fruits/Seeds: Fruits appear in late spring through summer; two-winged (samaras) with the wings almost horizontally (180° angle) divergent;[3] seeds are wind dispersed with low fall rates (estimated dispersal distance of 50 m or 164 ft);[7] germination with cold stratification for 90-120 days;[2,1] seed bank potential.[5]

Habitat: Introduced into the U.S. from Europe in 1756[11] and planted extensively in urban and suburban areas;[2] now also found on roadsides and waste places, in hedgerows and roadside thickets;[3] also spreading into early[4] and some late-successional forests;[6,11,10] withstands sandy, clayey, and acidic and calcareous soils; somewhat resistant to drought and tolerates ozone and sulfur dioxide; overplanted tree with a splitting bark problem; USDA hardiness zones 4 to 7.[2]

Comments: Shade tolerant;[11,8] leaves hold late in autumn and root system tends to be shallow;[8,2] at least 36 cultivars; susceptible to wilt, anthracnose, tar spot, and leaf scorch;[2] regenerates prolifically under its own canopy, possibly reducing overall diversity;[6,11] greater investment in foliage than stem and roots may make it less competitive in drier, open environments.[8]

Similar Native Species: Sugar maple (*A. saccharum*); does not produce milky juice; samara wings are at an angle, and leaf scars do not meet.[4,3,2]

NORWAY MAPLE

Acer platanoides **L.**

TREE OF HEAVEN
[*Ailanthus altissima* (Mill.) Swingle, *A. glandulosa* Desf.]
AIAL

Habit: Deciduous tree to 30 m (98 ft) in height.[4]

Reproduction: By seed and vegetatively via root suckering.[8]

Leaves: Pinnately compound to 1 m (3 ft) in length with 11-41 leaflets, each with a 'thumb' or lobe at the base; leaflet teeth have glands.[8]

Stems: Bark gray and smooth; younger twigs covered with a light brown to reddish brown pubescence; thick or chubby tips; may grow up to 2 m (6.5 ft) in one season.[4]

Flowers: Dioecious; hermaphrodites exist;[8] bloom June to July; may flower as early as 6 weeks after germination;[6] typically insect pollinated by a variety of pollinators, including bees.[3]

Fruits/Seeds: Two-winged samara (180°) with one central seed; sets late summer; over 300,000 seeds per tree documented;[1] seeds may remain on the tree through winter;[4,14] wind dispersed; cold stratification not required for germination;[11] seed bank formation thought unlikely,[16] though found as part of an urban forest seed bank.[15]

Habitat: Native to China; several introductions into the U.S. since 1784;[7] found in poor and rich soil on steep and shallow slopes, urban areas, open fields and woodlands, and closed canopy forests; often associated with disturbed habitats;[12,14] USDA hardiness zones 4-8.[4]

Comments: Extensive cloning;[16] at least 5 cultivars;[4] crushed leaves, stems, and roots smell of rancid peanut butter; allelopathic properties present,[13] though negative effects may be less severe if previously exposed;[17] tolerant of several air pollutants;[10,18,20] seedlings are drought resistant;[21] quassinoid compounds may deter some insect herbivory[9] and frugivory,[19] but seeds and tissue may be preyed upon by deer, mice, and voles,[5,19,2] even preferentially in the case of some invertebrates.[2]

Similar Native Species: Sumacs (*Rhus glabra*, *R. typhina*); walnuts (*Juglans nigra*, *J. cinerea*); none of the crushed leaves or broken stems of these have the same odor; fruits not samaras.[8]

TREE OF HEAVEN

Ailanthus altissima **(Mill.) Swingle**

GLOSSARY

Acidic: pH less than 7; releases protons (hydrogen ions, H+) in water.

Actinorhizal: symbiotic relationship of nitrogen-fixing bacteria with plant roots; less common than the rhizobia (*Rhizobium* and *Bradyrhizobium*) nitrogen-fixing bacteria that are often associated with legumes.

Alkaline: pH greater than 7; releases hydroxyl ions (OH-) in water.

Allelopathic: ability to inhibit the growth of another plant species using toxic chemical substances.

Annual: a plant that completes its life cycle in 1 year—germinating from seed, flowering, setting seed, and dying in one growing season.

Anther: enlarged terminal pollen-bearing portion of the stamen.

Aril: fleshy, often brightly colored, tissue covering some seeds.

Asexual: reproduction without union of gametes (i.e., union of sperm (in the pollen) and egg (in the ovule) in plants); includes vegetative and clonal growth.

Awn: bristle-like structure; often associated with grass flowers.

Axillary: the point where the leaf base or leaf petiole meets the stem.

Biennial: grows vegetatively for the first year, then flowers and dies the next.

Bilabiate: 2-lipped (petals of a flower); bilaterally symmetrical in shape.

C_4: photosynthetic pathway that uses CO_2 more efficiently (at a higher energy cost) by allowing storage of CO_2 in bundle sheath cells and reducing photorespiration; there is less need for gas exchange and open stomates; C_4 plants are well adapted to high light, high temperatures, and low moisture.

Chasmogamous flower: open; may outcross.

Cleistogamous flower: closed; must self-fertilize.

Clonal: producing vegetative offshoots that can survive on their own from the same parent.

Collar: the leaf margin at the intersection of blade and sheath surrounding the stem.

Compound: two or more similar parts of the same structure (such as flowers or leaflets).

Congener: belonging to the same genus.

Connate: united or fused parts.

Corymb: a flat-topped inflorescence with outer flowers on longer pedicels compared to the inner flowers; central flower is the youngest.

Cultivar: a variety of a plant species occurring only under cultivation (though they may escape into the wild).

Cuneate: wedge shaped (or triangular), narrowing to the point of attachment.

Cyme: a flat- or round-topped (or scorpioid) inflorescence where the central (or upper) flowers are older and the outer (or lower) flowers are youngest.

Deciduous: all leaves shed each year.

Dioecious: male and female unisexual flowers on separate plants.

Diploid: having two complete chromosome sets (2n).

Dormancy (for seeds): arrested growth, requiring either further embryo development or an environmental cue for germination to occur.

Drupe: fleshy, one- to several-seeded fruit with a stony inner layer.

Embolism: filling of vascular tissue (vessels and tracheids) with air after water columns rupture (cavitation); such air pockets prevent the flow of water.

Evergreen: with leaves that persist for more than one growing season.

Fecundity: ability to reproduce; number of offspring produced.

Fertilization: two reproductive haploid cell nuclei (each with one chromosome set or 1n) fuse together, forming a zygote (with two sets of chromosomes or 2n).

Frugivory: consumption of fruit.

Fruit: the mature ovary of a plant containing seeds.

Generalist: an organism seeking a broad range of resources, such as in pollination of flowers, herbivory, or frugivory by insects.

Germination: beginning or resumption of growth (usually in reference to a seed).

Glabrous: smooth, no hairs.

Glaucous: waxy, bluish green.

Grain: dry, one-seeded fruit, characteristic of grasses.

Guttation: water expelled from leaf tissue, often along the margins, caused by root water pressure.

Gynodioecious: female flowers and perfect flowers on separate plants.

Habit: general look or growth form of a plant.

Herbivory: consumption of live plant tissue.

Hermaphrodite: one flower having both functional sexes; same as perfect.

Hexaploid: having 6 complete chromosome sets (6n).

Inflorescence: a flower cluster**.**

Internode: section of stem between two nodes.

Leaf scar: scar left on a twig from a fallen leaf.

Limiting: scarce resource, i.e., N limiting, means nitrogen is scarce.

Linalool: a fragrant liquid alcohol.

Lycopene: red carotenoid pigment; an antioxidant; commonly found in tomatoes.

Mesic: wet or moist.

Monocarpic: flowering and fruiting once, then dying; also called semelparous; opposite is polycarpic or iteroparous, where organisms reproduce more than once before dying.

Monoecious: male and female unisexual flowers contained on one plant.

Mycorrhiza: a fungus and plant root mutually beneficial association (symbiosis); mycorrhizae is plural.

N: nitrogen (nitrate, nitrite, ammonium).

Native: plant species naturally occurring in a given range, not introduced to an area by humans.

Nectaries: glands that secrete nectar.

Nitrate: NO_3-; one of the preferred forms of nitrogen for uptake by plants.

Nitrification: oxidation of ammonium ions (NH_4+) or ammonia (NH_3) to nitrate (NO_3-) by free-living soil bacteria.

Nitrogen fixation: conversion of gaseous nitrogen (N_2) into nitrogen compounds by free-living and symbiotic bacteria; more appropriately called dinitrogen fixation.

Node: place of attachment of leaf to stem.

Nodule: swellings on the roots of legumes and other plants inhabited by nitrogen-fixing bacteria.

Oblong: sides parallel with ends rounded; longer than broad.

Obovate: egg-shaped but connected at the narrow end.

Ocrea: stipular stem sheath above the leaf base; ocreae is plural.

Octoploid: having 8 complete chromosome sets (8n).

Outcrosser: an individual (i.e., plant) that may be fertilized by another individual of the same species (but not of the same clone), receiving new genetic material.

Palmate: radiating out from a central axis.

Panicle: a branching inflorescence with pediceled flowers; flowers mature at the base first, then upwards.

Papilionaceous: butterfly-shaped; common in pea or bean flowers.

Pedicel: stalk that bears a single flower.

Peltate: petiole attached at or near the middle of the underside of a leaf, but not going through the leaf.

Perennial: living 2 years or longer.

Perfect: bisexual, having both male and female reproductive organs; usually referring to flowers.

Perfoliate: leaf surrounds the stem or petiole; stem or petiole goes through the leaf blade.

Perianth: petals and sepals of a flower collectively; most often used when petals and sepals look very similar.

Petiole: leaf stalk.

pH: measure of acidity and alkalinity that is the negative logarithm of the effective hydrogen ion concentration.

Pinnate: arranged on opposite sides of a central axis; i.e., a column of leaflets or veins on each side.

Pollination: pollen transferred from an anther to a stigma (or archegonium neck of gymnosperms); may lead to fertilization.

Polyploidy: having three or more complete chromosome sets.

Protandrous: with male reproductive organs maturing prior to those of the female (pollen dispersing before female structure is receptive).

Pubescent: with hairs.

Raceme: unbranching, prolonged inflorescence producing stalked flowers, maturing from the base upward or outward.

Ray: one of the branches of an umbel.

Recurved: curved backwards.

Reflexed: bent backwards.

Rhizomatous: with rhizomes (underground stems that can send up new shoots).

Rosette: radiating cluster of leaves at ground level.

Samara: closed, dry fruit with wings.

Scarification: seed coat degradation that often facilitates germination.

Seed: fertilized ovule with a hard coat, embryo, and sometimes endosperm (food storage for embryo).

Seed bank: seeds present in the soil and persisting for various time periods (longer than one season).

Self-compatible: individual that is capable of fertilizing itself.

Selfed: self-fertilized.

Senescence: life cycle stage from full maturity to death; can be used to describe a whole plant or parts of a plant (such as the leaves).

Shade intolerant: grows well or preferentially in high light conditions and less well in low light conditions.

Shade tolerant: grows well or preferentially in low light conditions.

Sheath: leaf base surrounding the stem.

Silique: dry fruit, splitting with each half or valve separating from the other and leaving a central thin septum.

Simple: only one, or not divided.

Spatulate: spatula-shaped; with rounded, broad top portion and narrowing to the base.

Specialist: an organism seeking a specific resource (narrow range), such as in pollination of flowers, herbivory, or frugivory by insects.

Spike: unbranched inflorescence with flowers without pedicels (sessile).

Spikelet: a small, prolonged spike subtended by one or two bracts (in grasses and sedges).

Stamens: male sex organ of a flower that produces pollen; composed of anther and filament.

Stock: a plant part united with another plant part (the scion) of the same or a different species and supplying mostly underground parts; uniting stocks to scions is grafting.

Stratification: seed exposure to different (often colder) temperatures to promote germination.

Successional: directional pattern of plant community regeneration or colonization; i.e., going from bare ground or old field to young forest (early successional) to mature forest (late successional).

Sucker: root or stem offshoot emerging from beneath the soil to produce a new plant.

Suture: the line or seam where a mature fruit splits.

Tendril: modified leaf in the form of a narrow, coiling structure, providing climbing support for a plant.

Tetraploid: having 4 complete chromosome sets (4n).

Translocate: to transport over a long distance water, minerals, or food within one individual or among ramets (individuals) of a clone.

Truncate: straight or flat-based as if cut off.

Umbel: flowers of a flat-topped or rounded inflorescence with equal length pedicels arising from a single point.

Variety: in the taxonomic hierarchy, a lower than species division being either equivalent to subspecies level or less; naturally formed (not cultivated).

Vegetative: propagation using asexual means; non-reproductive plant parts.

Venation: vein pattern found in leaves.

Viability: possibility of survival (i.e., of a seed to form a plant).

Xeric: dry.

Invasive Plants Field and Reference Guide:

An Ecological Perspective of Plant Invaders of Forests and Woodlands

NA-TP-05-04

Citations and Photograph Information Section

Cynthia D. Huebner[1,2]

with
Cassandra Olson[3]
and
Heather C. Smith[2]

[1] **Author for Correspondence (chuebner@fs.fed.us)**

[2] **USDA Forest Service**
Northeastern Research Station
Morgantown, WV 26505

[3] **USDA Forest Service**
Forest Inventory and Analysis
North Central Research Station
St. Paul, MN 55108

Citations and Photograph Information
Alphabetized by Habit and Species Latin Name

Herbs

Alliaria petiolata

Text Citations:

1. Anderson, R.C. and T.M. Kelley. 1995. Growth of garlic mustard *Alliaria petiolata* in native soils of different acidity. Transactions of the Illinois State Academy of Science 88(3 and 4): 91-96.
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Photograph Information:
Basal leaves (photographer: Jil M. Swearingen, USDI National Park Service); flowers (photographer: John Randall, The Nature Conservancy); plant (photographer: Dan Tenaglia, www.missouriplants.com); mature fruit (photographer: Britt Slattery, USFWS). Photographs reproduced from www.forestryimages.org or www.invasive.org (mature fruit).

Fallopia japonica

Text Citations:

1. Adachi, N. 1996. Nitrogen translocation via rhizome systems in monoclonal stands of *Reynoutria japonica* in an oligotrophic desert on Mt. Fuji: Field experiments. Ecological Research 11: 175-186.
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Photograph Information:
Leaves (Jack Ranney, University of Tennessee); leaves and flowers (Britt Slattery, U.S. Fish and Wildlife Service). Photographs reproduced from www.invasive.org.

Heracleum mantegazzianum

Text Citations:

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Photograph Information:

Leaves (photographer: Donna R. Ellis, University of Connecticut), inflorescence (photographer: Terry English, USDA APHIS PPQ), and seeds (photographer: USDA APHIS Archives). Photographs reproduced from www.invasive.org.

Microstegium vimineum

Text Citations:

1. Barden, L.S. 1987. Invasion of *Microstegium vimineum* (Poaceae), an exotic, annual, shade-tolerant, C_4 grass, into a North Carolina floodplain. American Midland Naturalist 118(1): 40-45.
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Photograph Information:
Flower, leaf, and sheath close up (photographer: David. J. Moorehead, The University of Georgia); population (photographer: Chuck Bargeron, the University of Georgia). Photographs reproduced from www.invasive.org.

Vines

Celastrus orbiculatus

Text Citations:

1. Brizicky, G. 1964. The genera of Celastrales in the Southeastern United States. Journal of Arnold Arboretum. 45: 206-218.
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Photograph Information:
Leaves, close up fruit, and plant with fruit (photographer: James H. Miller, USDA Forest Service, SE Research Station). Photographs reproduced from www.forestryimages.org.

Lonicera japonica

Text Citations:

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Photograph Information:
Leaves and flowers (photographer: Chuck Bargeron, University of Georgia); leaves (photographer: Ted Bodner, Southern Weed Science Society); fruit (photographer: Ted Bodner, Southern Weed Science Society). Photographs reproduced from www.invasives.org.

Polygonum perfoliatum

Text Citations:

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Photograph Information:
Flowers inside ocrea (photographer: Jil M. Swearingen, USDI National Park Service); fruit (photographer: Yun Wu, USDA Forest Service); leaves (photographer: Britt Slattery, U.S. Fish and Wildlife Service). Photographs reproduced from www.forestryimages.org and with permission of Yun Wu.

Pueraria montana var. *lobata*

Text Citations:

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Photograph Information:
Fruit, leaves, and flowers (photographer: Ted Bodner, SE Research Station, USDA Forest Service). Photographs reproduced from www.invasive.org.

Shrubs

Berberis thunbergii

Text Citations

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Photograph Information:
Leaves and flowers (photographer: Leslie J. Mehrhoff, University of Connecticut); fruit (photographer: Barry Rice, sarracenia.com); plant (photographer: Jil M. Swearingen, USDI National Park Service). Photographs reproduced from www.invasive.org.

Elaeagnus umbellata

Text Citations:

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Photograph Information:
Leaves, flowers, and shrub in flower (photographer: James H. Miller, USDA Forest Service, SE Research Station); fruit (USDA, NRCS). Photographs reproduced from www.invasive.org.

Lonicera maackii

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Photograph Information:
Fruit (photographer: Chuck Bargeron, The University of Georgia); stems and leaves (photographer: James H. Miller, USDA Forest Service, SE Research Station). Photographs reproduced from www.invasive.org.

Rhamnus cathartica

Text Citations:

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Photograph Information:
Leaves (photographer: J.S. Peterson, USDA NRCS NPDC, Missouri Botanical Garden, www.plants.usda.gov); fruit (photographer: Gary Fewless, www.uwgb.edu/biodiversity/herbarium/trees/); flowers (photographer: M.H. Brand et al., University of Connecticut, www.hort.uconn.edu).

Rosa multiflora

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Photograph Information:
Flowers and fringed stipule (photographer: James H. Miller, USDA Forest Service, SE Research Station); fruit (photographer: David J. Moorhead, University of Georgia). Photographs reproduced from www.invasive.org.

Trees

Acer platanoides

Text Citations:

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Photograph Information:
Leaf and flowers (photographer: Paul Wray, Iowa State University), and samara (photographer: Bill Cook, Michigan State University) Photographs reproduced from www.forestryimages.org.

Ailanthus altissima

Text Citations:

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Photograph Information:
Leaves and twig with mature fruit (photographer: James Miller, USDA Forest Service, SE Research Station); fruit with reddish color, not all cultivars have this color (photographer: Chuck Bargeron, University of Georgia). Photographs reproduced from www.forestryimages.org.

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